PROJECT **facts**

DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
FEDERAL ENERGY TECHNOLOGY CENTER

ADVANCED CLEAN/EFFICIENT
POWER systems

PS024.1197M

DEVELOPING THE SECOND-GENERATION FUEL CELL — THE M-C POWER PROJECT

PRIMARY PROJECT PARTNER

M-C Power Corporation
Burr Ridge, IL

MAIN SITES

San Diego, CA
(Demonstration)

Burr Ridge, IL
(Manufacturing)

TOTAL ESTIMATED COST

Product Design Improvement

$104,216,627

San Diego Demonstration

$29,326,821

COST SHARING

Product Design Improvement	
DOE	**$70,861,366**
Non-DOE	**$33,355,261**
San Diego Demonstration	
DOE	**$16,571,222**
Non-DOE	**$12,755,599**

FETC
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Project Description

The M-C Power Corporation, headquartered in Burr Ridge, Illinois, has tested the prototype of the next generation of fuel cell technology in San Diego, California, and is now in a 5-year development effort (1994-1999) to improve the design and reduce costs for the first market-entry units.

Molten carbonate fuel cells operate at higher temperatures (in excess of 1200°F) than first-generation phosphoric acid systems (which run at about 400°F). Higher operating temperatures increase power-generating efficiencies and correspondingly decrease emissions of carbon dioxide, a greenhouse gas. A molten carbonate fuel cell operates at nearly twice the efficiency of a coal combustion plant, reducing carbon dioxide emissions by nearly 50%.

The unit installed in San Diego, at the Miramar Naval Air Station, generated 250 kilowatts of electricity. Also, heat produced by the fuel cell was used in adjacent buildings at the site. This cogeneration approach raises overall efficiencies to nearly 85% — meaning that 85% of the energy value of the fuel is used.

Because fuel cells produce electricity and heat by an electrochemical process — like a battery — they emit virtually none of the sulfur and nitrogen pollutants associated with combustion processes.

Prior to the San Diego test, M-C Power tested its configuration in four 11-square-foot stacks, the largest size to be fabricated to date. In the 250-kilowatt stack, 250 of these full-size cells are assembled into a compact module.

The first project began in September 1990, and the latest in December 1994. The total effort is expected to end in December 2000.

The first unit was installed in Brea, California, and was operated in 1995. The second unit was operated at Miramar Naval Air Station in San Diege in 1997. This unit operated for 2,350 hours and delivered 158 megawatts per hour of direct current ouptut and 296,500 pounds of 110 psig steam to the base.

This program consists of three separate projects. The first is a $60.5 million contract, which includes $18.1 million from M-C Power. The second is for $30.8 million, including $14.2 million from M-C Power. The third is a $104 million product development and improvement project, with $33 million from M-C Power.

Developing the Second-Generation Fuel Cell — The M-C Power Project

Program Goals

The M-C Power demonstration in San Diego provided valuable experience in installing and operating a molten carbonate fuel cell in a commercial cogeneration application. Fuel cell modules comparable in size to those installed at the demonstration site will be linked together for larger power plant applications. The demonstration, coupled with the company's continued product development, will keep the United States the world's leader in advanced fuel cell technology.

The program goals are to commercialize the MCFC by 2002. Commercialization of the technology supports DOE goals for emissions reduction and energy security.

Project Benefits

Fuel cells have emerged as one of the most promising new power-generating technologies.

Endorsed by President Clinton's Climate Change Action Plan, fuel cells are an environmentally clean, quiet, and highly efficient method for generating electricity and heat from natural gas and potentially other fuels.

Molten carbonate fuel cell technology is becoming increasingly attractive because it offers several advantages over today's market-entry (phosphoric acid) fuel cell systems:

- Fuel-to-electricity efficiencies can exceed 55%, well above the 33%-35% efficiencies of today's conventional power plants and the 40% to 45% efficiencies of phosphoric acid systems; when the waste heat is utilized, total thermal efficiencies can approach 35%.
- The higher operating temperatures (approximately 1,200°F, compared with 400°F for first-generation systems) make the molten carbonate fuel cell a better candidate for combined-cycle applications (where exhaust heat is used in a steam cycle to generate additional electricity).
- The technology is expected to be much lower in capital cost, approaching $1,200 per installed kilowatt, or less than today's conventional coal-fired power technology.
- The technology exceeds all current and envisioned environmental regulations, producing water and CO_2 as the only emissions (the amount of CO_2 released per unit of electricity is considerably less than current power-generating technologies because of the higher efficiencies).

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Bechtel Corporation
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Stewart and Stevenson
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Electric Power Research Institute
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Southern California Gas
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Institute of Gas Technology
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